

an alcoholic drink, not requiring digestion, will supply the necessary energy to sustain life until the diseased organs have time to regain the power to assimilate better food. But to the healthy body there is no need of such a whip and spur, and the stimulus of alcohol upon the secretions of the digestive tract, frequently applied, is likely to result in overstimulation of the organs, and consequent weakness, with a long train of evils to follow.

As a food, alcohol is of little value compared with other substances. It is more expensive than almost anything else that is ever used as food, and cannot by itself sustain life; for, while it does generate a certain amount of energy, the body is really feeding upon the stored-up proteids, and the cost of the few spoonfuls of whisky or brandy, or the quart of beer which may perhaps be drunk without immediate bad effects, would buy of wholesome bread and meat enough to produce in the body many times the amount of normal force which the alcohol imparts.

**358. Alcohol as a Poison.** — The beneficent use of alcoholic drink seems to be wholly confined to its application as a medicine to diseased conditions of the system, and with that sort of use we have here nothing to do. It has been demonstrated that a healthy man may consume drink, in twenty-four hours, which contains from two to two and a half ounces of alcohol without apparent injury, when all circumstances are as favorable as possible for the perfect action of all the bodily organs. But it by no means follows that it would be equally safe for a man in the varying and uncertain conditions of ordinary life to incur the risk of disturbing the nice balance of the physical adjustment upon which vigorous health depends by introducing into his organism an element which *may*, and more likely than not *will*, disorder the action of some one or more of the

delicate organs. Let him take just a little more than the exact amount which can be at once oxidized in the blood or other tissue, and it is carried on through the system as alcohol, to work its characteristic effects. In the stomach the alcohol may harden the albumin of the food, and so prevent its complete digestion. If strong enough, it may attack the albumin in the cells of the lining of the stomach itself. This is the reason for the well-known fact that alcoholic drinks do less harm if taken after a meal than if taken on an empty stomach. A large quantity of strong drink taken at once seems to paralyze the nerves controlling the absorbents in the stomach, and often results in sudden death. Passing into the circulation, alcohol, as we have already seen in respect to yeast, acts directly upon the vitality of the living cells, hindering their growth and, when strong enough, wholly destroying their vital power. Any excess beyond the amount which can be oxidized at once interferes with normal cell activity, and works various physiological evils, as pointed out in different chapters of this book. All these are the actions of a *poison*.

**359.** In the *stomach* alcoholic fluids of all sorts increase very greatly the flow of gastric juice, and it would appear that this stimulation might assist digestion. But since the alcohol is found to disappear wholly from the alimentary tract within half an hour, this direct influence upon the secretion of gastric and other digestive juices can be but slight. Moreover, excessive or abnormal stimulation of any organ results ultimately in the weakening of its functional power. In the healthy animal wholesome food supplies all the stimulus needed by the various digestive organs.

In the *intestines* alcohol is rapidly absorbed into the blood. By dilution with the juices of the mouth and the



stomach its power for direct injury has already been reduced; but if the work of the stomach has been imperfectly done because of its presence, more labor remains to the intestines, and that may disorder the whole system.

360. The portal vein carries the alcohol absorbed from the stomach and the intestine directly to the *liver*. Here its evil effects in developing disease are earliest and oftenest apparent. Alcohol in the liver, as in other places, greedily uses up the oxygen needed for the necessary vital operations. In that way it prevents the normal action of the hepatic cells, for not enough oxygen remains for them to do their work perfectly. Now the liver, as the largest organ in the body, has a correspondingly important part to play in the vital processes, and any interference with its functions is extremely serious. It is well known to physicians that a drunkard's liver presents a greatly modified appearance, which is seen to a less degree in the liver of a moderate drinker. Alcohol does not build useful tissue, but instead it promotes the abnormal deposit of fat cells, causing what is called "fatty degeneration." This is often seen in the liver of alcohol users and causes enlargement of the organ; the connective tissue, also, is sometimes inflamed and hardened. Because of the imperfect action of the liver, poisons which should have been neutralized are allowed to circulate through the system and undermine its health.

So it appears that throughout the digestive tract alcohol is liable to work harm to the organs more or less serious in proportion to the frequency of its use and its amount.

361. Other Sources of Danger from Alcoholic Drinks. — Many of the drinks containing alcohol contain also a mixture of nutritious substances, such as unfermented sugar and

other foods found in the vegetables used in the manufacture; though no one drinks those beverages for the sake of the trace of nourishing matter in them. But there are formed along with the alcohol in fermentation other products, some of which are known to be directly poisonous, while others are at least probably injurious. Fusel oil and various ethers are among these substances. Another source of danger is found in the frequent adulteration of alcoholic beverages. The great expense attending their manufacture leads to the use of inferior materials, impure sugars, defective fruits, etc., and to the addition of poisonous coloring and flavoring matters. In some cases even so virulent a poison as strychnine has been found. These adulterations still further menace the health of the users of such drinks.

362. The Most Dangerous Quality of Alcohol. — Bad as it is to suffer from enfeebled physical conditions, it is yet worse to become weak in mind and unstable in moral character. No one will deny that such weakness and instability are results of the excessive use of alcoholic liquors. But no man ever lived who deliberately determined to make himself a *drunkard*, when first beginning to taste the exhilaration of the moderate use of such beverages. Every one thinks he will confine himself to the small quantity which he believes will do him no harm. How is it, then, that in all the great cities of the world certain streets are by night full of the sounds of crazy drunken revelry; that prisons are crowded with criminals made such by involuntary acts when "in liquor"; that myriads of human beings tumble every year into drunkards' graves, dying as the beast dieth, all the beauty and dignity of life wrecked long before, all hope, all possibility of rescue long since abandoned?



We class alcohol among the foods because it comes within our definition of food, but in a higher degree than any other substance used for food, it possesses a peculiar power which is not characteristic of food. It is the power of developing a progressive craving, an uncontrollable appetite for itself, which is never satisfied, and which leads the wine bibber to long ever for more and stronger wine, or whisky, or gin, or brandy. It is easy to say, "I will never drink any more alcohol in a day than the two ounces and a half which science has proved can be wholly oxidized in the body, yielding force and conserving to the extent of its own service the physical powers." The man who speaks thus *may* indeed be able so to regulate his actions, but millions of his fellow-men have not been able to do so. Men do not rightly estimate the full force of the insidious power of alcohol to create an ever-growing appetite which demands ever more alcohol for its satisfaction. Bread and meat and milk and fruit, which build the tissues and supply the forces for vigorous and worthy life, do not create an abnormal appetite for themselves. Sometimes a man or a woman indulges in the excessive use of tea or coffee, and may possibly experience something of the unhealthy craving for those beverages which the drunkard has for his liquor. But harmful as the effect of such indulgence is upon the physical system, it does not so undermine the mental and moral health as does the alcoholic habit.

363. It is at least *perfectly safe* to avoid wholly the use of alcoholic beverages. One who does so is certain to escape the frightful danger of acquiring that overmastering appetite for alcohol, to satisfy which he *might* become willing to commit murder or arson, or any other crime, and for whose indulgence he *may* be led to ruin all his hopes of happi-

ness for this world and for the world to come, and crush out all joy from the lives of those dear to him. What is the wise course for a being endowed with reason?

#### DEMONSTRATIONS AND EXPERIMENTS

111. *A General Dissection of the Digestive Organs* can be performed on the body of a rat, cat, dog, or rabbit. In this dissection other viscera besides the digestive organs should be examined. Just how much of the dissection is to be done by pupils, if any at all, must be left to the judgment of the teacher. Whether the actual class work takes on the nature of a dissection or merely of a demonstration, the attempt should be made to examine, as far as possible, every organ described in the text. To show the villi, cut out a piece of the wall of the small intestine, and after gently washing it examine the inner surface with a hand lens. Teeth of various animals can be obtained to show the arrangement in the jaws and the general structure and materials of a tooth.

112. *Minute Structure of Digestive Organs.*—Some prepared microscopical sections of various parts of the digestive tract will aid the pupil greatly in understanding the structure and properties of the alimentary organs. Very instructive are sections of the wall of the esophagus; of the stomach, showing the three muscular coats; of the small intestine; and sections of a salivary gland and of the liver. Tissues of any of the domestic animals can be used.

*Experiments in Digestion.*—It should be borne in mind that digestion carried on in test tubes is not normal, and that these experiments in digestion are merely illustrative.

113. *Salivary Digestion.*—To a test tube about half full of starch solution<sup>1</sup> add a little saliva and place the tube where the temperature can be kept at about 37° C. (98° F.). In a few minutes the starch solution becomes clear, and while at first it gave the characteristic reaction with iodine it now no longer turns blue, but if Trommer's test (Ex. 96) be applied, turns yellow, showing presence of sugar. To

<sup>1</sup> Rub a gram of laundry starch into a paste with a little cold water. Then add a hundred cubic centimeters of boiling water, and boil for a few minutes. Cool before using.



be sure that the sugar is a product of digestion, Trommer's test should be applied to the solution before saliva is added, and also to dilute saliva.

Prepare two other test tubes in a similar way, but boil the contents of one, and place the other on ice, or in a very cool place. From this conclusions may be drawn regarding the relation of temperature to the activity of the ferment of saliva.

The saliva of some persons has little or no digestive effect, hence this experiment will occasionally fail.

114. *Gastric Digestion*.—Fill three test tubes about half full of artificial gastric juice,<sup>1</sup> and three other test tubes with (1) water, (2) water containing a little powdered pepsin, and (3) a  $\frac{2}{10}$  per cent muriatic acid solution, respectively. Place in each test tube a few shreds of fibrin. Fibrin is used because it is a solid proteid, and the progress of its digestion can be followed with the eye, without making special tests. Boiled white of egg may be used, but it digests more slowly. Boil one test tube containing artificial gastric juice, place a second on ice, and set away the other test tubes in a warm (37° C.) place.

In a short time the fibrin in the tube of gastric juice kept in the warm place is seen to be much swollen, and gradually it disappears in solution. Compare the test tube with the others. What effect has temperature on gastric digestion? Is the presence of pepsin necessary? Does pepsin alone (in water) digest the fibrin?

115. *Action of Gastric Juice on Milk*.—To a test tube about half full of fresh milk, add a little artificial gastric juice that has been neutralized by the addition of dilute carbonate of soda. Keep at a temperature of about 37° C. (98° F.). In a short time the milk curdles. In previous experiments on milk, curdling was produced by acids; here, since the gastric juice was neutralized, it is due to some other cause. To the test tube add a little dilute muriatic acid to acidulate the contents, and keep it in the warm place for several hours. The casein is finally digested in the presence of acid, forming a straw-colored fluid.

116. *Action of Rennet on Milk*.—To some fresh milk in a test tube add a little commercial extract of rennet, and keep at a tempera-

<sup>1</sup> Add a little powdered pepsin (to be obtained at a druggist's) to a  $\frac{2}{10}$  per cent solution of muriatic (hydrochloric) acid.

ture of about 37° C. The milk curdles in a few minutes. In the previous experiment the milk was curdled by the rennin ferment in the artificial gastric juice.

117. *Action of Pancreatic Juice on Starch*.—Repeat Ex. 113, using, instead of saliva, artificial pancreatic juice.<sup>1</sup>

118. *Action of Pancreatic Juice on Proteids*.—Repeat Ex. 114, using artificial pancreatic juice instead of gastric juice, and carbonate of soda solution instead of muriatic acid.

119. *The Emulsifying Effect of Pancreatic Juice*.—Rub together, in a mortar, some olive oil, or cod-liver oil, with pieces of fresh pancreas. An emulsion results. Shake together in a test tube some olive oil and a little artificial pancreatic juice, as used in preceding experiments. An emulsion occurs as before. Boil some artificial pancreatic juice to destroy the ferment. It still forms an emulsion with oil. In the experiments on fats (Exs. 97-100) it was seen that an alkali, or a soluble proteid, forms an emulsion with fats. Natural pancreatic juice contains both alkali and proteids. Hence, even when boiled, pancreatic juice emulsifies fats.

120. *Bile*.—Obtain bile at a slaughterhouse. Observe its color. Test with litmus paper. It is neutral or alkaline if fresh.

121. *Action of Bile in Fats*.—Shake some olive oil in a test tube, with five times its bulk of bile. Make a similar mixture of olive oil and water, and observe in which case the emulsion lasts longer. Shake up bile with olive oil, to which a little oleic acid is added. The emulsion lasts longer than before.

122. *Action of Bile in Filtration and Absorption*.—Into each of two small funnels of exactly the same size, put a filter paper. Moisten one with water and the other with bile. Pour into both equal amounts of almond oil, and after covering to prevent evaporation, set aside twelve to fourteen hours. The oil passes through the filter moistened with bile, but scarcely at all through the other.

<sup>1</sup> Add a little powdered pancreatine to a 1 per cent solution of carbonate of soda. Commercial pancreatine commonly contains both the starch-digesting ferment, *amyllopsin*, and the proteid-digesting ferment, *trypsin*.



## CHAPTER XXVI

### PUBLIC HYGIENE, OR GENERAL SANITATION

519. Definition.—As **personal hygiene** is the art and the science of preserving the individual body in health, so **public hygiene** is the art and science of promoting the health of the community. A healthy man is one whose body is sound and vigorous in all its parts, so that all the functions of the system are performed perfectly, easily, and without discomfort; no one of all the organs neglecting or failing to do the work assigned it, and so deranging or poisoning other organs.

A healthy village or city is one in which most of the inhabitants are healthy, and especially one in which contagious and infectious diseases do not pass from one person to another.

We have learned that a man, in order to maintain his health, must have pure air, pure water, and wholesome food. But in crowded towns and cities even the wealthiest citizens are not able to procure these simple necessities for themselves. The carelessness of some obscure and ignorant person may poison the water supplied to rich and poor alike; germs of disease from the most squalid part of a city may be borne by the air, by the gas of a sewer pipe, or in any one of a thousand other ways to carry death to a palace many miles away. A single filthy dwelling may poison a whole town. It is not enough

that intelligent persons should themselves live according to sanitary laws; it is necessary to their health that the ignorant and careless should also be obliged to do so. This cannot be brought about by individual influence or authority. Hence it has come to pass that in all civilized communities some degree of control is exercised by the officers of the government over the personal habits and ways of life of private persons. Many of the laws given by Moses to the Hebrews and preserved in the Scriptures relate to sanitary matters connected with daily life, and it is believed that obedience to those laws has had much to do with the fact that the Jews, throughout their history, have been remarkably free from great epidemics of disease. Neglect of sanitary precautions is, on the other hand, understood to be responsible for the frightful "plagues" which often swept over the earth in past ages, destroying many thousands of lives. They arise even yet in the filthy cities of Oriental countries, but are now far less destructive and more easily kept within bounds.

Our knowledge as to what the power of government can do to promote the health of a community has been increasing rapidly in recent years, but that knowledge is far from being thoroughly applied, because the people in general are not yet intelligent enough to demand it.

520. Knowledge of Sanitary Laws Essential to Good Citizenship.—In a free, democratic government, such as ours, proper attention to sanitary matters on the part of public officers depends upon an intelligent and active public sentiment. Since the people are the government, it is the duty of the people—all the people—to see to it that their servants, the officers appointed to protect them against the dangers of unsanitary conditions in any part



of the town or city, shall do their duty. No man can be a really good citizen who is ignorant of the conditions which threaten the general health, or who neglects to use his influence to keep the health officers watchful and active. The subject of sanitation should therefore receive attention in our schools, and may properly be considered briefly in connection with the study of physiology.

521. **A Healthy Town or City** is one in which the poorest inhabitants have pure air to breathe, pure water to drink, wholesome, unadulterated food to eat, and opportunities for cleanliness in person and dwelling. These conditions can be supplied only by the strong arm of a central power supported by an enlightened public opinion. And having provided these prime necessities, the central power of government should require all citizens to make use of them. A man should not be permitted to use the foul water from a filthy well, even on his own premises; nor to keep his own dwelling in so uncleanly a state as to endanger the health of his own family and that of his neighbors; if public washing conveniences are provided he should even, if necessary, be obliged to have the clothing of his family cleansed and his own body bathed.

522. **Cleanliness the One Essential.**—The conditions of general physical well-being may after all be reduced to one, viz. *cleanliness*, taken in its broadest, fullest sense. That would include clean air, clean water, unadulterated food, cleanliness of person and clothing, and adequate exercise by which purity of blood is promoted and removal of the poisonous waste of the body is secured.

523. **Pure Air.**—A man can live for a considerable time without food or water, and he may within certain limits safely select what he will eat and drink. But he cannot

live for a single hour without air, and he is unable to select what air he will use, for he must breathe that which immediately surrounds him. Several things are needful that the air of a dwelling or other building may be fit to breathe.

(1) *Drainage of the Ground on which a House stands.*—More or less of the air in a building comes from the ground beneath and around it. A wet soil favors the multiplication of the bacteria always present in the ground, and among them are often germs of specific disease. Water is found at varying distances everywhere beneath the earth's surface, and, in order that a spot may be fit for building upon, what is called the *ground water* should be not less than fifteen feet below the surface (some authorities say thirty feet), and the level should not greatly vary from time to time. That a house may be healthful, the soil beneath it must be thoroughly drained by pipes laid deep enough in the ground; and public authorities should have power to see that this is done.

(2) *Ground Air should so far as possible be excluded from a House.*—The air in a house is usually warmer than that outside, and so there is a tendency to *suck up* the air in the porous ground below. Even if the soil is dry, there are often gases from decaying vegetation or other sources, which are more or less injurious to life, mixed with the earth. These should be excluded from the house by covering cellar walls and floor with an impervious coating. Care must also be taken that nothing is left to decay in the cellar or any other part of a building.

(3) *Sunshine is necessary to Health* and to the purity of the air in a house. No room is fit for human occupancy if it does not at some time receive the direct rays of the sun. Many dangerous germs are killed outright by direct



sunlight. Those persons who live habitually shut out from sunshine never have strong, buoyant health.

It is not yet common for public authorities to interfere in respect to this matter. In our cities it is even permitted to one citizen to cut off completely from his neighbor's family this prime necessity to well-being.

524. *The Air in Streets and Alleys* is often rendered offensive and dangerous by accumulations of filthy refuse from dwellings, stables, factories, etc. Neglect of prompt and thorough cleansing of all such passages by the officials whose duty it is, should never be tolerated for a day, and cleanliness of private premises should also be legally enforced.

525. *Pure Food*. — Governmental inspection of the various foods offered for sale is now recognized as an important duty. Diseased meat, adulterated milk, butter, lard, cheese, etc., are supposed to be excluded from the markets, while adulterated sugars, baking powder, spices, etc., are doubtless less common than formerly. But occasionally an outbreak of typhoid fever or other fatal disease is traced to the carelessness or ignorance or cupidity of some dealer in dairy products, and hundreds of poor families are found to be suffering in health from the adulterated bread or flour or other necessary sold by an unscrupulous dealer. The inspection of foods should be made much more strict, and should be enforced in the smaller communities as well as in the large cities.

526. *Pure Water*. — Nothing is more essential to the health of a community than an abundant supply of wholesome water for drinking, and good citizens look well to the source of their drinking water. Water from small streams, rivers, or lakes is seldom, in thickly settled parts of the world, pure enough for drinking until it has been treated

by some of the various methods now in use for freeing it from the unwholesome matters almost always present. It is true that running streams and lakes exposed to the action of sun and wind are purified to a considerable extent by natural influences, and where they do not receive an excessive amount of the waste of towns and factories, may usually be safely used. But very often the filth of a city or of several cities is poured continually into the lake or river which supplies the inhabitants with drinking water, the amount of poison being far more than nature is able to destroy. In such cases many and complicated devices are used for getting rid of the injurious substances. The water may be drawn off into large reservoirs and allowed to *settle*. Then, the coarser filth having been deposited, the water may be drawn into other reservoirs and treated with certain chemicals which will cause the *precipitation* of other substances as sediment. Some chemical substances destroy organic matter by oxidizing it, and sometimes the same result is obtained by forcing air through the contaminated water.

Water is also partly purified by *filtering* through various porous materials—large beds of sand, gravel, and broken stone, for instance. The filtering body itself soon becomes clogged with filth, and must be often renewed or cleansed.

None of these processes destroys all the dangerous germs to be found in impure water, and it is a wise precaution for every family to boil for half an hour all water for drinking which comes from a source liable to contamination. The water may then be placed in glass cans, tightly closed, and cooled in a refrigerator, or in a cellar. By this course much illness and death in large towns, where typhoid fever and other water-borne diseases are always



present, would be prevented. The same care should be taken in the country, when the drinking water comes from springs or shallow wells.

Probably the safest source of a water supply is from *deep wells*, sunk far below any possible befoulment from the surface. Many towns are now thus supplied. Ordinary wells and cisterns are seldom safe, unless great care is used. The leakage from a barnyard or cesspool many rods away may find its way into a well through the layers of earth, and poison the water. Rain water is mixed with dust from the air and the roof, with bits of leaves and other organic matter, and should be thoroughly filtered and boiled for drinking.

Ice (unless manufactured from distilled water) contains impurities, and should not be put into water used for drinking.

527. **Public Bathing and Washing Conveniences** are now provided by the most progressive cities, and contribute much to the health of the people. They should be free, or so nearly so that the poorest families may be able to enjoy the luxury of cleanliness.

528. **Disposal of Garbage and Sewage.**—Not only must the daily waste in towns and cities be gathered up and removed from sight, but it must also be treated in some way which shall destroy its dangerous character. It must not be dumped upon vacant lots in the poorer quarters of the town, and left to decay and poison the air. And it is seldom safe to pour it into neighboring water ways or lakes. Various devices have been tried for the better disposal of the poisonous waste of human life, no one of which is absolutely *best* for all localities. That which is most desirable for a particular community must be determined in view of all circumstances and surroundings.

No *cheap* and safe method has yet been discovered. All are expensive, but any one is cheaper than the sacrifice of life and health which is sure to result from unsanitary or slipshod ways of dealing with this serious problem. Some of the most satisfactory methods in use in the most progressive cities may be simply mentioned here.

Where a very large body of water is at hand, which is not the source of the town's water supply, the sewage may, for a time at least, be safely poured into it. This is the cheapest way. But such pollution of streams and lakes is now forbidden by law in many countries of Europe, as it should be in the United States. In some cities the sewage is collected in great vats, where the solid portion is separated from the liquid, and sold for use as a fertilizer. The liquid is by chemical treatment freed from its harmful ingredients, and poured into the water-courses. Some cities own large farms, to which the sewage is conveyed in close tanks, and spread upon the soil as a fertilizer. In other cases the soil is simply used as a filter. The sewage is spread upon it, and the liquid which filters through is received by drain tiles laid below the surface, and carried into a natural stream. The solid portion is decomposed by the action of air, sun, and bacteria, which render it harmless.

Garbage and the solid portion of sewage are frequently consumed in great furnaces, that which remains indestructible by fire being safely used for filling up low places about the city.



**Vis'ce-ra** (Lat., plu. of *viscus*, perhaps akin to Eng. *viscid*): the organs contained in the abdomen.

**Vital knot**: the nervous center in the medulla oblongata which presides over the coördination of the respiratory movements. If the medulla be divided below this center respiration ceases and death results.

**Vit're-ous humor** (Lat. *vitreus*, of glass): the jellylike substance filling the posterior chamber of the eyeball.

**Viv-i-sec'tion** (Lat. *vivus*, living, and *sectio*, a cutting): dissection of a living body.

**Vo'cal cords** (Lat. *vox, vocis*, voice): bands of elastic tissue in the mucous membrane of the larynx which act upon the air like the reeds of a musical instrument to produce musical sounds.

**Vo'mer** (Lat., a plowshare): a small bone forming part of the partition between the nostrils.

**Yellow spot**: an area about one twenty-fourth of an inch in diameter in the retina of the eye, upon which the most definite images are formed.

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